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## SUSTAINABE SHIPPING[1]

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### Abstract

The purpose of this paper is to take stock at recent developments as regards sustainable shipping and discuss prospects for the future. The exposition focuses on recent developments and draws, to a great extent, from a recent book published by the author.

Key words: Sustainability, shipping, green shipping

### 1. Introduction and background

International shipping is currently at a crossroads. The decision of the 72nd session of the Marine Environment Protection Committee (MEPC 72) of the International Maritime Organization (IMO) in April 2018 to achieve by 2050 a reduction of at least 50% in maritime green house gas (GHG) emissions vis-à-vis 2008 levels epitomizes the last among a series of recent developments as regards sustainable shipping. It also sets the scene on what may happen in the future. Even though many experts and industry circles believe that the MEPC 72 decision is in line with the COP21 climate change agreement in Paris in 2015, others disagree, either on the ground that the target is not ambitious enough, or on the ground that no clear pathway to reach the target is currently visible.

This debate actually goes even further and transcends maritime transportation. The COP21 climate change agreement itself was hailed by many as a most significant achievement, but others were not equally enthusiastic. The decision of American president Trump to steer the United States away from COP21 has caused disappointment or even consternation to the broad spectrum of nations that endorsed the Paris agreement and has injected a new dose of uncertainty as to what may happen to climate change. Irrespective of the U.S. path, the COP21 agreement upheld the non-inclusion of international shipping (as well as aviation) within its mandate, something that has received mixed reviews by the international community. The rationale for the non-inclusion has been that action in these two sectors is within the mandate of the IMO for international shipping, and of the International Civil Aviation Organization (ICAO) for aviation. Some industry circles think this is correct, however environmental groups perceive this as a sign of inability or unwillingness to act and are not happy about it.

Before COP21, the most sweeping piece of regulation pertaining to maritime GHG emissions reduction was the adoption of the so-called Energy Efficiency Design Index (EEDI) by the IMO. This was agreed upon at MEPC 62 in July 2011. This was a no-

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consensus decision, as adoption was put to a vote in which a group of developing countries (such as China, India, Brazil, Saudi Arabia, South Africa and others) were firmly against the agreement. During the same session, the Ship Energy Efficiency Management Plan (SEEMP) was also adopted.

2011 was also the year the European Union (EU) adopted the new Transport White Paper, which targets drastic reductions in GHG emissions from all modes of transport in the EU by 2050. An aggregate 60% reduction vis-à-vis 1990 levels is stipulated. The target for maritime transportation GHG emissions reductions is 40% and if possible 50%. Such targets are highly ambitious because the stipulated reductions are non-trivial. However, and even though a detailed implementation plan has also been proposed in the White Paper, at least for maritime transportation it is not clear how or if the above reduction targets can be realized.

There have also been some setbacks. For instance, the discussion on a possible adoption of Market Based Measures (MBMs) for GHGs, initiated in 2010 at the IMO and entailing a comprehensive review of some 11 MBM proposals, was finally suspended in 2013. Relevant discussion was re-channelled toward a system for Monitoring, Reporting, and Verification (MRV) of $CO_2$ emissions. Progress after COP21 was equally mixed. At the IMO, a roadmap was agreed in October 2016. The roadmap foresaw the adoption of an Initial Strategy in 2018 to meet the targets of COP21, which entered into force in November 2016. The strategy will be validated by actual emission figures gathered through the IMO's fuel Data Collection System (DCS) as of 2019. This would then lead to a final agreement on targets and measures, including an implementation plan, by 2023. The April 2018 IMO decision was an important link in the chain of events that will lead to 2023.

On the more controversial side, perhaps the most significant development has been the February 2017 vote of the European Parliament (EP) to include shipping into the EU Emissions Trading System (ETS) as of 2023, in case no global agreement is reached by 2021, and the subsequent (November 2017) alignment of the EU process with that of the IMO. The EP vote had raised extensive voices of protest from industry circles such as ECSA (European Community Shipowners Associations), ICS (International Chamber of Shipping) and many national ship owner associations. The shipping industry is concerned that an EU ETS may create significant distortions and obstacles for efficient trade, may not be compatible with the IMO roadmap, and in fact may not be a good instrument for reducing GHG emissions.

Given the above, the following questions are relevant: where does shipping currently stand as regards sustainability, and what are the prospects for the future? At first glance these questions may look easy to pose. However, we shall see that they are not so easy to address.

To define "sustainable shipping," let us look at Figure 1.

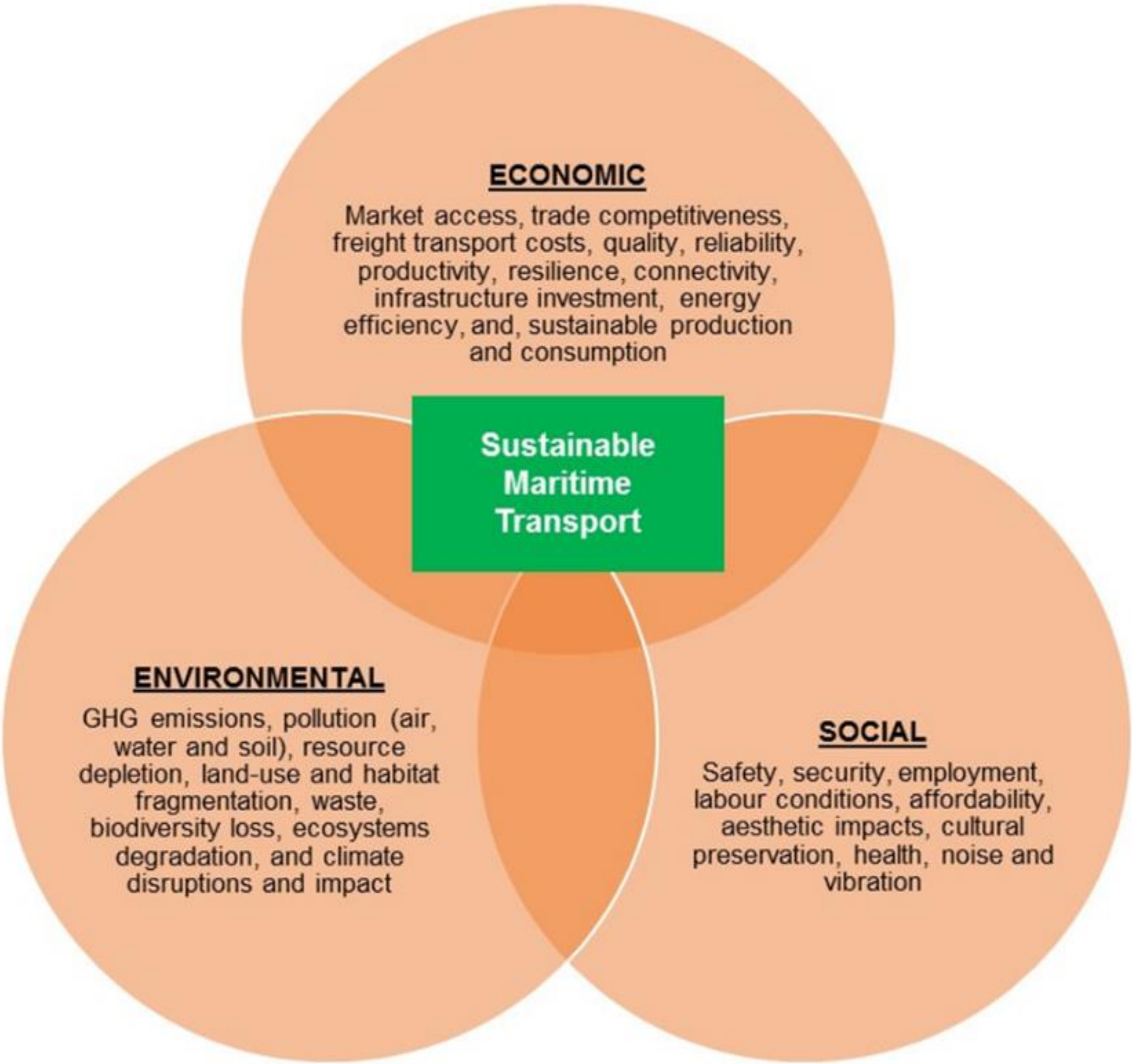


**Fig. 1: Defining Sustainable Maritime Transport. Source: UNCTAD secretariat, Sustainable Freight Transport Framework, 2017. Reproduced from Benamara et al. (2019)**

One can see from Figure 1 that a great number of factors are at play as regards sustainable shipping. In addition, and aside from the considerations of Figure 1, it should also be realized that sustainability in general, at least as reflected in the United Nations Sustainable Development Goals (UN SDGs), includes additional issues such as poverty, hunger, gender equality, education, and several others[2]. However, for the specific perspective of this paper, of most interest is the interaction between the *environmental*

[2] For a list of the UN SDGs see [https://www.un.org/sustainabledevelopment/sustainable-development-goals/](https://www.un.org/sustainabledevelopment/sustainable-development-goals/)

and the *economic* dimensions, and how one can achieve a balance between environmental and economic objectives. Achieving such a balance is important as it would make no sense for a ship, a shipping operation or a maritime supply chain system to be performing well environmentally but be non-viable from an economic perspective. Achieving "win-win" solutions is therefore an indispensable prerequisite for sustainable shipping. *Social* criteria such as safety, security, employment, labor conditions, health and others are also important in their own right.

To achieve sustainable shipping, a spectrum of technical, logistics-based and market based measures are being contemplated. However, which are the best measures to choose is far from obvious. All may have important side-effects as regards the economics and logistics of the maritime supply chain, including ports and hinterland connections. The objective to attain an acceptable environmental performance, while at the same time respecting traditional economic performance criteria so that shipping remains viable, is and is likely to be a central goal for both industry and policy-makers in the years ahead.

If one is to take "a cross-disciplinary view" of the various dimensions of the maritime transportation sustainability problem, a variety of angles can be used to examine the various topics, and these mainly include the technological angle, the economics angle, the logistics angle, and the environmental angle. Even though GHG emissions are the main element of the environmental angle, other relevant environmental topics include sulphur ($SO_x$) emissions, oil pollution, ballast water management and ship recycling.

The rest of this paper is organized as follows. In Section 2 we highlight selected issues in sustainable shipping. In Section 3 we discuss the way ahead. Finally Section 4 makes some final remarks.

## 2. Sustainable shipping: selected issues

For an indicative spectrum of relevant issues, we look at Psaraftis (2019a), a book looking at sustainable shipping that was recently published. Below we provide summaries of the book contents. We emphasize that the treatment of the subject in this book is certainly not encyclopedic.

Benamara et al. (2019) identify the linkages between shipping and sustainable development and highlighting what are the stakes in sustainable shipping, who are the stakeholders, what are the trade-offs, what are the policy issues, what may be the obstacles and enablers of sustainable shipping and the role of international institutions including the IMO and UNCTAD (the UN Conference on Trade and Development).

De Kat and Mouawad (2019) look at the topic of technological solutions for sustainable shipping. These include air lubrication, wind assisted propulsion and solar power, waste heat recovery systems, ballast water management systems, more efficient (energy-saving) engines, more efficient ship hulls and designs, more efficient propellers, hybrid systems, and others, both for the main engine and the auxiliary engines.

Polakis et al. (2019) look at the only regulatory measure thus far in place to reduce GHG maritime emissions, EEDI. They go over the rationale for EEDI and the factors that are important. Also they go over related concepts, such as the SEEMP plan and the Energy Efficiency Operational Indicator (EEOI) and the Existing Vessel Design Index (EVDI). Possible weaknesses of EEDI and how to improve the EEDI are also presented.

Fjørtoft and Berge (2019) look into ICT (Information and Communication Technologies). These do not lead to direct environmental benefits, but their smart use can definitely do so, by increasing the efficiency of the maritime supply chain, improving safety, improving the load factor, etc. They also review relevant ICT systems in shipping and consider their impact on improving environmental performance.

Ventikos et al (2019) highlight the most significant attributes of oil pollution in the context of the sustainable shipping. They present the current legislative framework for the environmental protection against oil pollution and depict the utility of the implementation of Risk Control Options (RCOs). Furthermore, the measures of containment of the oil pollution cost are illustrated along with the incorporation of the environmental risk evaluation criteria in IMO's Formal Safety Assessment (FSA). Finally, the authors discuss feasible ways of achieving a sustainable future without undermining the environmental integrity.

Mikelis (2019) addresses the recycling of ships, otherwise known as dismantling, ship breaking, scrapping, and demolition. He also outlines the efforts to implement existing international legislation to ship recycling, and the development of the Hong Kong Convention, and provides a critical analysis of the development of regional legislation by the EU. He finally discusses the combination of voluntary and legislative mechanisms that will secure the global implementation of minimum standards for safe and environmentally sound ship recycling.

Zis and Psaraftis (2019) present an overview of the main issues of sulphur emissions and the legislative framework that seeks to reduce the sulphur footprint of the maritime sector. It also analyses potential modal shifts towards less efficient land-based modes which may happen as a result of sulphur regulations, and investigates the related potential economic damage to ship operators. To that effect, the authors present a methodological framework that can be used to estimate such modal shifts, as well as to measure the efficacy of possible measures to reverse such shifts.

Wang et al. (2019) examine, from a tramp ship operator's point of view, how potential $CO_2$ emission reduction measures impact operational decisions, and their economic and environmental consequences. Two MBMs are discussed, the bunker levy scheme and the emission trading scheme, and it is shown that both can be incorporated in a similar way into a typical tramp ship routing and scheduling model.

Hellsten at al (2019) looked into green liner shipping network design problems, these being defined as problems in green logistics related to the design of maritime services in liner shipping with focus on reducing the environmental impact. The authors discuss how to more efficiently plan the vessel services with the use of mathematical optimization models.

Psaraftis (2019b) focuses on speed optimization. This involves the selection of an appropriate speed by the vessel so as to optimize a certain objective. As ship speed is not fixed, depressed shipping markets and/or high fuel prices induce slow steaming which is being practised in many sectors of the shipping industry. The author presents some basics, discusses the main trade-offs and also examines combined speed and route optimization problems. Some examples are presented so as to highlight the main issues that are at play, and the regulatory dimension of speed reduction via speed limits is also discussed.

Psaraftis and Woodall (2019) focus on the concept of MBMs to reduce GHG emissions from ships, and review several distinct MBM proposals that were under consideration by the IMO. They then move on to discuss the concept of MRV of $CO_2$ emissions and the distinct mechanisms set up the European Union (EU) and the IMO for MRV. The two issues are connected as a next possible step after MRV can be an MBM.

Zis (2019) examines the issues associated with a green port operation. These include technologies such as cold ironing, market based practices such as differentiated fairway dues, speed reduction, noise and dust abatement, and others. The legislative framework in various countries is explained and various environmental scorecards are discussed. He emphasize the implementation of speed reduction programmes near the port, use of cold ironing at berth, and the effects of fuel quality regulation, considering the perspectives of the port authority, and the ship operator.

Finally Psaraftis and Zachariadis (2019) look at the way ahead, with a focus on the April 2018 IMO Initial Strategy on how to reduce maritime GHG emissions. They include a section on alternative fuels, these figuring centrally among candidate measures included in the IMO Initial Strategy.

## 3. The way ahead

The exposition below is adapted from Psaraftis and Zachariadis (2019).

The reception of the April 2018 IMO/MEPC 72 decision (IMO, 2018) was almost universally laudatory. Industry associations including the International Chamber of Shipping (ICS), the Baltic and International Maritime Council (BIMCO), the European Community Shipowners Associations (ECSA), the International Association of Ports and Harbors (IAPH), the European Seaports Organisation (ESPO), but also the European Commission, the Organisation of Economic Cooperation and Development (OECD), and several non governmental organizations (NGOs), hailed the result as an important first step towards the eventual full decarbonization of shipping. There were very few expressions of dissatisfaction. For instance, the United States, which has backed out of the Paris Agreement anyway, did not vote for the Resolution. So did Saudi Arabia. Some environmental NGOs expressed disappointment with the result, and so did some members of the European Parliament.

Realizing that we are currently at a crossroads and the track that will be followed from now on is subject to many uncertainties, below we make a cursory and non-encyclopaedic attempt to comment on some additional issues that we think are important as international shipping moves towards 2050.

1. Eight years after the adoption of the Energy Efficiency Design Index (EEDI), which is still (together with the Ship Energy Efficiency Management Plan- SEEMP) the only mandatory GHG emissions reduction measure, there is no doubt that the April 2018 IMO/MEPC 72 decision was a landmark decision. Achieving GHG emissions in 2050 which are at least 50% lower than they were in 2008 is a substantial and ambitious target that has to be taken very seriously by all involved.
2. Any hope that substantial GHG reductions can be achieved by improvements on EEDI is in our opinion grossly unsubstantiated. Making maximum use of EEDI is included in the Initial IMO Strategy's short-term measures. However, in a study conducted for Danish Shipping, Smith et al. (2016) showed, among other things, that the existence of EEDI vs a scenario in which there is no EEDI as we move to 2050 amounts to a GHG emissions difference of about 3%.
3. The two stated principles that are centrally included in the Initial IMO Strategy (a) non- discrimination/no more favorable treatment and (b) Common But Differentiated Responsibilities and Respective Capabilities (CBDR-RC) are in direct conflict with one another. The latter principle was included so as to please the group of developing countries (mainly Brazil, Saudi Arabia, India, and others) who stood and continue to stand firmly behind CBDR-RC. In our opinion however, if there is a *single major obstacle* for any progress on maritime GHG emissions reduction, it is definitely CBDR-RC, and one will need to find a way to circumvent or even eliminate this principle altogether if any serious progress is to be made. We obviously realize that doing so may not be politically correct, and the risk is that the issue may destabilize an already rather very delicate process.
4. One year after the adoption of the Initial IMO Strategy, there is still no sense of priority among the wide array of candidate measures, all of which are on the table. Market Based Measures (MBMs) have been put into the medium-term class (to be agreed upon between 2023 and 2030) *but only as a possibility*, even though the Damocles sword of an European Union (EU) Emissions Trading System (ETS) is looming. There appears to be no sense of urgency for any MBM, not even for reopening the MBM discussion.
5. Related to this, it is unclear at this time what the EU will do. The European Parliament decided in November 2017 to align itself with the IMO process on GHGs but that the European Commission will monitor the IMO process very closely. Depending on the pace of the IMO process, and in particular if that pace is not deemed satisfactory, one could not rule out a scenario that the EU unilaterally moves on early, so as to include shipping within the EU ETS, or at least do this conditionally.
6. In the event that shipping is included in the EU ETS, which in our opinion would be unfortunate as it would create distortions, it would be interesting to see what the IMO would do. A plausible (in our opinion) scenario is for the IMO to reopen the

MBM discussion soon, at least so as to preempt EU action on ETS. But the political will to do so seems at this point invisible.

7. That GHG emissions are to reach a peak as soon as possible is a laudable goal, but raises the obligatory question, how soon. According to the 3rd IMO GHG study (IMO, 2014), in 2008, the baseline year as far as comparison to target values is concerned, $CO_2$ emissions of international shipping were estimated at 920.9 million tonnes, and declined to 795.9 million tonnes in 2012, even though they reached 849.5 million tonnes in 2011. As of yet, and pending the fourth IMO GHG study (which has been recently advertised and will be finalized in 2020) there is no consensus on GHG emissions figures after 2012. And even the above figures are based on the "bottom up" (activity based) method, whereas emissions figures based on the "top down" (fuel sales based) method are significantly lower (624.9 million tonnes in 2008 versus 648.9 million tonnes in 2011- there was no top down estimate for 2012). There should certainly be consensus on which method is used ("bottom up" numbers are 30% to 50% higher than "top down"), plus consensus on when the GHG peak is expected to occur. Barring any major world trade slowdown, it seems self-evident that for any GHG peak to be reached, some measures will have to be implemented- no peak will happen by itself.
8. The same is true as regards consensus on how "transport work" figures are defined. These are important so as to check the target of at least 40% CO2 emissions per transport work reduction in 2030 versus 2008 levels (and at least 70% by 2050). The 4th IMO GHG study is expected to estimate the 2008 transport work and CO2 emissions per transport work figures.
9. (Mandatory) "speed reduction" (or, speed limits) is included as a potential short term measure, even though the term "speed optimization" was added so as to make the measure more palatable to Chile and Peru, who are concerned about carrying cherries to China. Speed limits may seem at first glance like a reasonable measure, however they are plagued by various deficiencies and would create distortions and other problems. Still, it is a victory for the speed limit lobbyists (Clean Shipping Coalition and others) that this measure is now on the table at the IMO, only a few years after the IMO previously rejected it (at MEPC 61 in 2010). There has been serious lobbying for the speed limit measure recently by CSC and other advocates (which revently included France, Greece and more than 100 ship owners), however MEPC 74 did not endorse such measure. Given that it did not reject it either, the measure is still on the table.

Lack of prioritization among measures being an observation, and in the quest to meet the 2030 and 2050 targets, is there any measure that should receive priority? In our opinion there is. This is to impose a *significant* bunker levy at a global level. By significant we mean not 10 or 20 USD per tonne, as is being occasionally contemplated by industry, but *at least one order of magnitude higher*.

To put it very simply, if society truly does not like fossil fuels, or any other fuel that produces GHGs (and this includes LNG), and cannot, for obvious reasons, mandate their outright ban, society should at least try to implement the *"polluter pays"* principle by internalizing (even partially) the external costs of GHGs. The only way to do so is by putting a significant price on the fuels that produce these GHGs. Conversely, and so long as these fuels are affordable, there is no doubt that they will be used. All the debate on LNG, hydrogen, and other alternative fuels (see Bouman et al. (2017), DNV GL (2018), OECD (2018), and Psaraftis and Zachariadis (2019), among others) critically hinges upon the economic dimension: we would like to know not only how much GHGs these alternative fuels would avert, but also what is the cost of producing and using them. Conversely, and barring a technological quantum leap, for as long as these alternative fuels are not viable economically, they will not be used.

An important parenthesis here is that, and in order to avoid modal shifts to land-based modes, such a levy should not be confined to the maritime mode, and care should be taken to prevent modal shifts which could increase overall GHG levels. This is particularly true not only for short sea shipping (SSS) scenarios but also for longer distance deep sea services, especially now that the Belt and Road Initiative (BRI) is being pursued by China so as to link Asia and Europe.

A substantial bunker levy would induce technological changes in the long run and logistical measures (such as slow steaming) in the short run. In the long run it would lead to changes in the global fleet towards vessels and technologies that are more energy efficient, more economically viable and less dependent on fossil fuels than those today. A levy would also raise monies that could be used for “out-of-sector” GHG emissions reductions, aid to Least Developed Countries (LDCs) and Small Island Developing States (SIDS), and other purposes.

However, the prospects of such a development on MBMs are, as things stand, very slim. Very few stakeholders seem to be interested in it. For a comparison between speed limits and a bunker levy see Psaraftis (2019c).

In a paper that was published a few months *before* the April 2018 IMO decision (Psaraftis, 2018), the following statement was made: *“.. in spite of much talk about the maritime industry’s commitment toward serious GHG emissions reductions, it is fair to say that such reductions are, as things stand, only a wish at this point in time.”* Based on what we have seen since then, including MEPC 72, 73 and 74, we see no significant reason to retract the above statement. It is true that the April 2018 IMO decision has opened a new door and maybe created some momentum. However, substance-wise and in order to guarantee significant GHG emissions reductions in the future, one would have to abandon the BAU stance that still seems to pervade much of what is done in the maritime industry today and not be afraid to take bolder steps, even if these entail some political cost.

## 4. Final remarks

Two last issues that are relevant on the subject of sustainable shipping are nuclear marine propulsion and how the various emissions reduction options may impact climate change, and more specifically the mean temperature of the planet.

Nuclear marine propulsion is currently confined to naval vessels and ice-breakers and there is nothing a priori obvious that would preclude its consideration in commercial shipping. In fact a distinct advantage of nuclear propulsion is the complete elimination of GHG and other operational emissions. However, issues such as safety, disposal of radioactive waste and economic viability are also important. Proponents of the nuclear option argue that such issues have been resolved.

It is noted here that the nuclear option is not included (at least as of yet) as one of the candidate measures postulated by the IMO in their April 2018 decision. To be more precise, the nuclear option is not explicitly excluded by the IMO as a potential measure, however this option is not visible in any of the current discussions on alternative (low carbon or zero carbon) fuels to reduce maritime GHG emissions. This is so in spite of the fact that a GHG emissions reduction goal of at least 50% would seem to encourage a stance not to exclude any solutions, however radical these solutions may seem. However, political considerations, especially after the Fukushima accident in Japan, seem to be a factor that currently weighs against the use of this option in commercial shipping. Whether or not this exclusion continues as we move towards 2050 is not clear at this point in time. Readers interested in the topic are referred to the work of the Royal Academy of Engineering[3], of Lloyd's Register[4], and of Hirdaris et al. (2014), among others.

The final issue is how various emissions reduction options may impact climate change, and more specifically the mean temperature of the planet. This is true not only as regards GHGs, but also as regards other emissions. For instance, the anticipated drastic (but largely unknown) reduction of maritime $SO_x$ emissions as soon as the global 0.50% sulphur cap kicks in as of 1/1/2020 will reduce the "radiative cooling" effect caused by $SO_x$ emissions in the atmosphere. As such, it may increase global warming. But what the increase will be is basically unknown (for a discussion of the relevant issues see Eyring et al. (2010) and more recently Gratsos (2018), among others). In addition, producing vast quantities of low sulphur fuels would certainly require some energy, which, if not from renewable or nuclear sources, would also increase global $CO_2$. Again, the impact of this development on climate change is by and large unknown.

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